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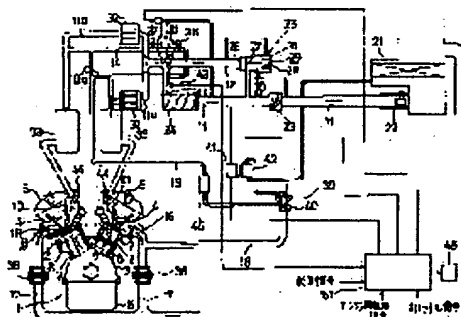
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## (54) EGR CONTROL DEVICE FOR ENGINE INCORPORATING SUPERCHARGER

## (57)Abstract:

PURPOSE: To prevent exhaust gas from counterflowing through a bypass passage which also serves as a relief passage, in order to prevent the exhaust gas into a supercharger by stopping the instruction of the exhaust gas into the bypass passage when a shut-off valve opens an intake passage incorporating an intercooler and a shut-off valve closes a part of the bypass passage.

CONSTITUTION: A first shut off valve 34 opens and closes an intake passage, upstream of an intercooler 32 but downstream of a part from which a relief passage 12 branches, and a second shut-off valve 35 opens and closes a bypass passage constituting the upstream side of the relief passage 12. An EGR means 39 introduces a part of exhaust gas into the bypass passage 14 downstream of the second shut-off valve, and a control means controls the EGR means 39. When the first and second shut-off valves 34, 35 opens and closes respectively, and the relief valve 25 opens, the introduction of the exhaust gas into the bypass passage 14 is inhibited. Accordingly, it is possible to prevent EGR gas from counterflowing through the bypass passage and flowing into a supercharge 24.



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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]****[0001]**

**[Industrial Application]** This invention relates to the EGR control unit which controls the exhaust gas reflux which flows back in an inhalation-of-air system in a part of exhaust gas in the engine equipped with the supercharger which supercharges inhalation of air.

**[0002]**

**[Description of the Prior Art]** Conventionally, as EGR equipment of the engine equipped with this seed supercharger, as shown in a publication-number No. 123272 [ two to ] official report, an EGR means to make exhaust gas flow back is formed in the inhalation-of-air path of the upstream of a supercharger, and the downstream, and the thing it was made to make exhaust gas flow back only under engine predetermined conditions to the inhalation-of-air path by the side of a supercharge style on board is known. However, the reflux exhaust gas will be inhaled by the supercharger, and making exhaust gas flow back to a supercharge style side on board has a possibility that the stick of a supercharger etc. may arise with carbon, moisture, etc. in exhaust gas, and it has a problem in respect of protection of a supercharger or dependability.

**[0003]** By the way, preparing the relief path which makes the inhalation of air breathed out from the supercharger relieve to a supercharge style side on board, and the relief control valve which open and close this relief path, making a relief control valve open, relieving a part of inhalation of air supercharged by the supercharger in an engine non-supercharging field, and making it make a supercharger inhale, while considering as the mechanical supercharger which always drives a supercharger with an engine conventionally is known.

**[0004]** And while preparing the intercooler which cools further the inhalation of air supercharged by the supercharger The upper section constitutes the upper section of the above-mentioned relief path, and the inhalation-of-air path of the surge tank upstream which a down-stream edge is the above-mentioned intercooler downstream, and has been arranged to the intercooler downstream is joined. The bypass path which makes an intercooler bypass the inhalation of air from a supercharger, From an intercooler, rather than a tee with a relief path by the upstream The inhalation-of-air path of the downstream, The closing motion valve arranged, respectively is prepared in the bypass path which constitutes the upper section of the above-mentioned relief path. And the time of an engine heavy load, and when the temperature of inhalation air and cooling water is high By closing the bypass path which opens the inhalation-of-air path of the downstream rather than a tee with a relief path by the upstream, and constitutes the upper section of a relief path from an intercooler by the above-mentioned closing motion valve While cooling the supercharged inhalation of air by the intercooler, at the time between the colds and of an engine low load, open and close a closing motion valve conversely, an intercooler is made to bypass inhalation of air, and the supercooling may be prevented.

**[0005]**

**[Problem(s) to be Solved by the Invention]** In such a supercharged engine, if exhaust gas is introduced into the inhalation-of-air path which has arranged the intercooler in making exhaust gas flow back in an

inhalation-of-air system as mentioned above, exhaust gas will usually be introduced into a bypass path from exhaust gas being cooled by the intercooler and there being a problem of an intercooler deteriorating by a part of the component. And there is an advantage which can mix exhaust gas to inhalation of air and fitness by installation of the exhaust gas to this bypass path by the time it results in the surge tank of the bypass path downstream.

[0006] however, with the structure where exhaust gas is introduced into a bypass path in this way On the other hand, the inhalation-of-air path of the downstream is opened by the closing motion valve rather than a tee with a relief path by the upstream from an intercooler in the non-supercharging field which is an engine. And if the bypass path which constitutes the upper section of a relief path is closed by another closing motion valve, reflux exhaust gas will flow into a supercharger inlet side through the relief control valve which flows backwards and is opening the bypass path from the relief path, and the problem that the dependability of a supercharger is spoiled will arise.

[0007] This invention was made in view of these many points, and the purpose is controlling the exhaust gas reflux in the above supercharged engines, and it is in preventing the exhaust gas flowing backwards a bypass path, and being inhaled by the supercharger, raising mixing with the inhalation of air of reflux exhaust gas.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, it was made to suspend the installation to the bypass path of exhaust gas in the condition that a part of bypass path which an inhalation-of-air path with an intercooler is opened with a closing motion valve, and is used also [ path / relief ] in invention of claim 1 is closed with a closing motion valve.

[0009] Namely, the supercharger 24 which supercharges inhalation of air in this invention as are shown in drawing 1 (a), and described above, The relief path 12 which makes the supercharger 24 upstream relieve the inhalation of air breathed out from this supercharger 24, The relief control valve 25 which opens and closes this relief path 12, and the intercooler 32 which cools the inhalation of air supercharged by the supercharger 24, The surge tank 33 formed in the downstream of this intercooler 32 and the upper section constitute the upper section of the above-mentioned relief path 12. A down-stream edge is the intercooler 32 above-mentioned downstream, and the inhalation-of-air path 11 of the surge tank 33 upstream is joined, and it is premised on the supercharged engine 1 equipped with the bypass path 14 which makes an intercooler 32 bypass the inhalation of air from a supercharger 24.

[0010] And the 1st closing motion valve 34 open and close the inhalation-of-air path 11 of the downstream rather than a tee with the relief path 12 by the upstream from the above-mentioned intercooler 32, The 2nd closing motion valve 35 which opens and closes the bypass path 14 which constitutes the upper section of the above-mentioned relief path 12, When form an EGR means 39 to introduce a part of exhaust gas in the bypass path 14 of this 2nd closing motion valve 35 downstream, and the above-mentioned 1st closing motion valve 34 opens further, the 2nd closing motion valve 35 closes and the above-mentioned relief control valve 25 is open, It is characterized by establishing the control means 52 which controls the above-mentioned EGR means 39 to forbid installation of the exhaust gas to the bypass path 14 of the 2nd closing motion valve 35 downstream.

[0011] By invention of claim 2, in the condition that a part of bypass path which an inhalation-of-air path with an intercooler is opened with a closing motion valve, and is used also [ path / relief ] is closed with a closing motion valve, the installation to the bypass path of exhaust gas is suspended, instead exhaust gas was introduced into the inhalation-of-air path of the bypass path downstream.

[0012] That is, by this invention, as shown in drawing 1 (b), in the supercharged engine of the same premise as invention of above-mentioned claim 1, the 1st closing motion valve 35 which opens and closes the inhalation-of-air path 11 of the downstream rather than a tee with the relief path 12, and the 2nd closing motion valve 35 which open and close the bypass path 14 which constitutes the upper section of the relief path 12 are similarly formed by the upstream rather than an intercooler 32.

Furthermore, EGR means 39' which introduces a part of exhaust gas into the inhalation-of-air path 11 of the downstream rather than the unification section of the bypass path 14 of the 2nd closing motion valve 35 above-mentioned downstream, or a bypass path 14 down-stream edge, When the above-mentioned

1st closing motion valve 34 closes and the 2nd closing motion valve 35 opens, while introducing exhaust gas into the bypass path 14 of the 2nd closing motion valve 35 downstream. When the above-mentioned 1st closing motion valve 34 opens, the 2nd closing motion valve 35 closes and the relief control valve 25 is open, control means 52' which controls EGR means 39' to introduce exhaust gas into the inhalation-of-air path 11 of the downstream rather than the unification section of a bypass path 14 downstream edge is prepared.

[0013]

[Function] In invention of claim 1, the 1st closing motion valve 34 is closed, and the 2nd closing motion valve 35 is opened, when the inhalation of air breathed out from the supercharger 24 bypasses an intercooler 32 and is supplied to an engine 1 via the bypass path 14 by the above-mentioned configuration, the EGR means 39 operates as it is, and a part of exhaust gas is introduced into the bypass path 14 of the 2nd closing motion valve 35 downstream by it. By installation of the reflux exhaust gas to this bypass path 14, by the time it results in the surge tank 33 of the bypass path 14 downstream, exhaust gas can be mixed to inhalation of air and fitness, and that mixing nature can be secured.

[0014] On the other hand, the 1st closing motion valve 34 is opened, and the 2nd closing motion valve 35 is closed, when the inhalation of air breathed out from the supercharger 24 is supplied to an engine 1 via an intercooler 32 and the relief control valve 25 is further open, actuation of the EGR means 39 is suspended by the control means 52, and installation of the exhaust gas to the bypass path 14 of the 2nd closing motion valve 35 downstream is forbidden. For this reason, reflux exhaust gas flows backwards the bypass path 14, and does not flow into a supercharger 24 from the relief path 12.

[0015] In invention of claim 2, the 1st closing motion valve 34 is closed, and the 2nd closing motion valve 35 is opened, and when the inhalation of air breathed out from the supercharger 24 is supplied to an engine 1 via the bypass path 14, a part of exhaust gas is introduced into the bypass path 14 of the 2nd closing motion valve 35 downstream by actuation of the EGR means 39 by control means 52'. On the other hand, the above-mentioned 1st closing motion valve 34 opens, and the 2nd closing motion valve 35 closes, and the inhalation of air breathed out from the supercharger 24 is supplied to an engine 1 via an intercooler 32. And when the relief control valve 25 is open, installation of the exhaust gas to the bypass path 14 of the 2nd closing motion valve 35 downstream is suspended, instead exhaust gas is introduced into the inhalation-of-air path 11 of the downstream by actuation of the EGR means 39 rather than the unification section of a bypass path 14 downstream edge. For this reason, the reflux to the inhalation-of-air system of exhaust gas can be secured, without causing that reflux exhaust gas flows backwards the bypass path 14, and flows into a supercharger 24 from the relief path 12.

[0016]

[Example] Hereafter, the example of this invention is explained based on drawing below drawing 2.

[0017] (Example 1) Drawing 2 shows the whole example 1 configuration of this invention, and 1 has one pair of banks 2 and 2 of a V type where it is a multiple cylinder engine and this engine 1 counters. An engine 1 consists of the cylinder block 3 of the letter of the cross-section abbreviation for V characters, one pair of cylinder heads 4 and 4 attached to the top face of this cylinder block 3, cylinder head covers 5 and 5 attached to the top face of each cylinder head 4, and an oil pan mechanism 6 attached to the inferior surface of tongue of a cylinder block 3. Gas columns 7 and 7 and -- are formed in each above-mentioned bank 2, respectively, in each of this gas column 7, the piston 8 is fitted in possible [ reciprocation ], it is surrounded by this piston 8 and cylinder head 4, and the combustion chamber 9 is formed. The exhaust air port 16 which constitutes the upper edge part of the flueway 17 where the suction port 10 which constitutes the down-stream edge part of the inhalation-of-air path 11 which supplies inhalation of air to the combustion chamber 9 of each gas column 7 discharges exhaust gas from the combustion chamber 9 of each gas column 7 in the side face of the opposite side between bank 2 and 2 again is formed in the bank 2 of each above-mentioned cylinder head 4, and the side face by the side of between two, respectively.

[0018] In the middle of the flueways 17 and 17 of the gas column 7 corresponding to each above-mentioned bank 2, the exhaust emission control device 38 was arranged, respectively, and both these flueways 17 and 17 have gathered mutually by the downstream of an exhaust emission control device

38.

[0019] The upper edge of the above-mentioned inhalation-of-air path 11 is connected to an air cleaner 21, and the air flow meter 22 which detects the amount of inhalation air, the throttle valve 23 which extracts the inhalation-of-air path 11, and the supercharger 24 which pressurizes inhalation air (inhalation of air) and supercharges are arranged in the inhalation-of-air path 11 of this air cleaner 21 downstream sequentially from the upstream. Let the above-mentioned supercharger 24 be the mechanical thing which is always connected with an engine 1 and carries out drive rotation. By the inhalation-of-air path [ of the supercharger 24 downstream ] 11, and throttle-valve 23 downstream, rather than the supercharger 24, the inhalation-of-air path 11 of the upstream is connected by the relief path 12 which makes the supercharger 24 upstream relieve the air breathed out from the supercharger 24, and the air bypass valve 25 as a relief control valve which opens and closes the relief path 12 is arranged in this relief path 12. The valve element 26 to which this air bypass valve 25 opens and closes the relief path 12, The diaphragm 28 connected with this valve element 26 through the shaft 27, and the pressure induction room 29 and the atmospheric pressure room 30 divided by this diaphragm 28, The pressure induction room 29 \*\*\*\* and it has the spring 31 which energizes a valve element 26 in the direction of clausilium. As the pressure induction room 29 is opened for free passage by the relief path 12 of the air bypass valve 25 upstream, and the atmospheric pressure room 30 is opened for free passage by the inhalation-of-air path 11 of the throttle-valve 23 upstream, respectively and it is shown in drawing 4 The opening of a throttle valve 23 in the small low load region of an engine 1 While making an air bypass valve 25 open and making the upstream relieve the regurgitation air of a supercharger 24, he carries out clausilium of the air bypass valve 25, and is trying to supply the regurgitation air of a supercharger 24 to an engine 1 in the heavy load region of the engine 1 with which throttle opening increases.

[0020] The inhalation-of-air path 11 branches by the downstream corresponding to each bank 2 of an engine 1 to two branching inhalation-of-air paths 11a and 11a rather than a part for a tee with the above-mentioned relief-path 12 upstream edge. The intercooler 32 and surge tank 33 which cool the air supercharged by the supercharger 24, respectively are arranged in each branching inhalation-of-air path 11a sequentially from the upstream. Each above-mentioned surge tank 33 is opened for free passage by the gas column 7 of each bank 2 where an engine 1 corresponds through the inhalation-of-air path 11 (independent inhalation-of-air path).

[0021] Moreover, the inhalation-of-air path 11 by the side of each above-mentioned intercooler 32 vertical style is connected at the bypass path 14 which bypasses each intercooler 32, respectively. The upper section of each of this bypass path 14 is used also [ section / of the above-mentioned relief path 12 / upper ], and has branched from the relief path 12 of the air bypass valve 25 upstream. The downstream edge of the bypass path 14 is the intercooler 32 above-mentioned downstream, and joins branching inhalation-of-air path 11a of the surge tank 33 upstream, and he makes the air from a supercharger 24 bypass, and is trying to make it flow down an intercooler 32 by each of this bypass path 14 on the other hand.

[0022] The same 2nd closing motion valve 35 which opens and closes this bypass path 14 upstream part is arranged in the inhalation-of-air path 11 of the downstream rather than the tee with the relief path 12 by the upstream from the above-mentioned intercooler 32 by the upstream part the 1st closing motion valve 34 which consists of a butterfly valve which opens and closes this inhalation-of-air path 11 uses the upper section of the relief path 12 also [ part ] at the bypass path 14 again, respectively. These double door clausiliums 34 and 35 are what interlocks mutually with one diaphragm-type actuator 36, and is opened and closed by hard flow. The above-mentioned actuator 36 Installation of the inhalation-of-air negative pressure of the throttle-valve 23 downstream to a pressure induction room (not shown) or disconnection to atmospheric air is alternatively performed by the change of a cross valve 37, and change-over actuation is carried out. The time of the heavy load of an engine 1, and when the temperature of inhalation air and cooling water is high While cooling the air pressurized with the supercharger 24 through an intercooler 32 by opening the 1st closing motion valve 34, and closing the 2nd closing motion valve 35, at the time between the colds and of the low load of an engine 1 He makes

the bypass path 14 which bypasses an intercooler 32 pass air, and is trying to prevent the supercooling by closing the 1st closing motion valve 34, and opening the 2nd closing motion valve 35.

[0023] The EGR equipment 39 which introduces a part of exhaust gas is formed in the bypass path 14 of the 2nd closing motion valve 35 above-mentioned downstream. This EGR equipment 39 has the EGR path 18 (exhaust gas reflux path) where multipoint connection of the upper edge was carried out to that exhaust-emission-control-device 38 upstream part in the flueway 17 corresponding to the bank 2 of the method of top Norikazu. The amount of [ of this EGR path 18 ] downstream branches to two branching paths 18a and 18a. He connects with the bypass path 14 of the 2nd closing motion valve 35 above-mentioned downstream, and is trying for each of that branching path 18a down-stream edge to introduce a part of exhaust gas in a flueway 17 into the bypass path 14 as an inhalation-of-air system, respectively.

[0024] Moreover, the check valve 45 which prevents that inhalation of air leaks to an exhaust air system in EGR valve 40 which controls the amount of reflux exhaust gas in the middle of and a predetermined supercharge field is arranged sequentially from the upstream. [ the above-mentioned EGR path 18 ] While opening EGR valve 40 in above-mentioned EGR valve 40 by the predetermined operating range (EGR field) of an engine 1 and making it introduce exhaust gas into the bypass path 14 as the inhalation-of-air negative pressure of the throttle-valve 23 downstream and the atmospheric pressure in an air cleaner 21 are controlled by the duty solenoid valve 41 and the cross valve 42, and are introduced and it is shown in drawing 4, the pressure using inhalation-of-air negative pressure and an atmospheric pressure adjusts the opening of the EGR valve 40 to it.

[0025] Moreover, the temperature sensor 43 which detects the intake-air temperature (regurgitation air temperature of a supercharger 24) of a there is arranged in the inhalation-of-air path 11 of the direct downstream of the above-mentioned supercharger 24. 44 are an injector which carries out injection supply of the fuel at the each about ten suction port independent inhalation-of-air path 11 among drawing 2.

[0026] Actuation control of the duty solenoid valve 41 and cross valve 42 for EGR valve 40 control is carried out by the engine control unit 51 at the cross valve 37 for a drive change-over of the above-mentioned double door clausiliums 34 and 35, and a list. The output signal of the above-mentioned temperature sensor 43, the water temperature signal showing the circulating water temperature of an engine 1, the signal of an engine speed, and the throttle signal that shows the opening of the above-mentioned throttle valve 23 which is a value relevant to the load of an engine 1 are inputted into this control unit 51 at least. Moreover, the warning lamp 45 as an alarm is connected to the control unit 51.

[0027] Here, the flow chart Fig. of drawing 3 explains the control algorithm when controlling the double door clausiliums 34 and 35 and EGR valve 40 in a control unit 51. First, the first step S1 It judges whether it set and the intercooler bypass execution condition which passes an intercooler 32 was satisfied in the regurgitation air from a supercharger 24. The time of this intercooler bypass execution condition having the operating range of the engine 1 distinguished based on an engine speed and throttle opening in a supercharge field (referring to drawing 4), and there being a circulating water temperature of an engine 1 beyond predetermined temperature is judged to be "formation." and when this judgment is YES of "formation" In step S2, intercooler bypass execution flag I as I= 1 which shows "activation" After this flag's I opening the 1st closing motion valve 34 and closing the 2nd closing motion valve 35, at the time of NO non-"materialized" step S3 after closing the 1st closing motion valve 34 and opening the 2nd closing motion valve 35 as I= 0 which sets and shows "it does not perform" for this execution flag I -- respectively -- step S4 It progresses. This step S4 It judges whether the EGR execution condition which flows back exhaust gas then was satisfied. This EGR execution condition judges the time (refer to drawing 4) of the operating range of the engine 1 distinguished based on an engine speed and throttle opening being in an EGR field to be "formation." When this judgment is NO non-"materialized", it is the first step S1. Although it returns, at the time of YES of "formation", it is step S5. It judges whether it progresses, an engine 1 is in a non-supercharging field, and the air bypass valve 25 is open. When this judgment is NO of the supercharge field of an engine 1, it is step S8. Target position Po spontaneously corresponding to the operational status of an engine 1 for actuation BOJISHON P of

EGR valve 40 After carrying out, it returns to the first step S1. When a judgment is set to YES of the non-supercharging field of an engine 1, it is step S6. It progresses and the above-mentioned intercooler bypass execution flag I judges whether it is  $I = 1$  which shows "activation." When this judgment is YES of  $I = 1$ , it is step S7. The first step S1 after setting and setting actuation BOJISHON P of EGR valve 40 to  $P = 0$  which shows the close by-pass bulb completely of EGR valve 40 It returns. Moreover, at the time of the judgment of NO of  $I = 0$ , it is the above-mentioned step S8. It progresses.

[0028] Moreover, the flow chart Fig. of drawing 5 explains the control algorithm when judging failure of the above-mentioned air bypass valve 25 by the control unit 51. First, in the first step S11, the air bypass valve failure judging flag F is set to  $F = 0$  which shows the all seems well of this bulb 25, and the detection value t of the above-mentioned temperature sensor 43 is set to regurgitation air temperature [ of a supercharger 24 ] T at the following step S12. Then, it progresses to step S13 and is the abnormality judging temperature T0 of the above-mentioned regurgitation air temperature T. Size is compared and this judgment is  $T \leq T0$ . When it is NO, they are remaining as it is and  $T > T0$ . At the time of YES, after making the above-mentioned air bypass valve failure judging flag F into F-1 which shows the abnormal condition of this bulb 25 at step S14, it progresses to step S15, respectively.



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**CLAIMS**

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**[Claim(s)]**

[Claim 1] The supercharger which supercharges inhalation of air, and the relief path which makes the inhalation of air breathed out from this supercharger relieve to a supercharge style side on board, The relief control valve which opens and closes this relief path, and the intercooler which cools the inhalation of air supercharged by the supercharger, The surge tank formed in the downstream of this intercooler and the upper section constitute the upper section of the above-mentioned relief path. In the supercharged engine equipped with the bypass path which a down-stream edge is [ path ] the above-mentioned intercooler downstream, and the inhalation-of-air path of the surge tank upstream is joined [ path ], and makes an intercooler bypass the inhalation of air from a supercharger The 1st closing motion valve open and close the inhalation-of-air path of the downstream rather than a tee with a relief path by the upstream from the above-mentioned intercooler, The 2nd closing motion valve which opens and closes the bypass path which constitutes the upper section of the above-mentioned relief path, When an EGR means to introduce a part of exhaust gas into the bypass path of the above-mentioned 2nd closing motion valve downstream, and the above-mentioned 1st closing motion valve open, the 2nd closing motion valve closes and the above-mentioned relief control valve is open, The EGR control unit of the supercharged engine characterized by establishing the control means which controls the above-mentioned EGR means to forbid installation of the exhaust gas to the bypass path of the above-mentioned 2nd closing motion valve downstream.

[Claim 2] The supercharger which supercharges inhalation of air, and the relief path which makes the inhalation of air breathed out from this supercharger relieve to a supercharge style side on board, The relief control valve which opens and closes this relief path, and the intercooler which cools the inhalation of air supercharged by the supercharger, The surge tank formed in the downstream of this intercooler and the upper section constitute the upper section of the above-mentioned relief path. In the supercharged engine equipped with the bypass path which a down-stream edge is [ path ] the above-mentioned intercooler downstream, and the inhalation-of-air path of the surge tank upstream is joined [ path ], and makes an intercooler bypass the inhalation of air from a supercharger The 1st closing motion valve open and close the inhalation-of-air path of the downstream rather than a tee with a relief path by the upstream from the above-mentioned intercooler, The 2nd closing motion valve which opens and closes the bypass path which constitutes the upper section of the above-mentioned relief path, When an EGR means to introduce a part of exhaust gas into the inhalation-of-air path of the downstream rather than the bypass path of the above-mentioned 2nd closing motion valve downstream or the unification section of the above-mentioned bypass path down-stream edge, and the above-mentioned 1st closing motion valve close and the 2nd closing motion valve opens, While introducing exhaust gas into the bypass path of the 2nd closing motion valve downstream, when the 1st closing motion valve opens, the 2nd closing motion valve closes and the above-mentioned relief control valve is open, The EGR control unit of the supercharged engine characterized by establishing the control means which controls an EGR means to introduce exhaust gas into the inhalation-of-air path of the downstream rather than the unification section of a bypass path down-stream edge.

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[Translation done.]

